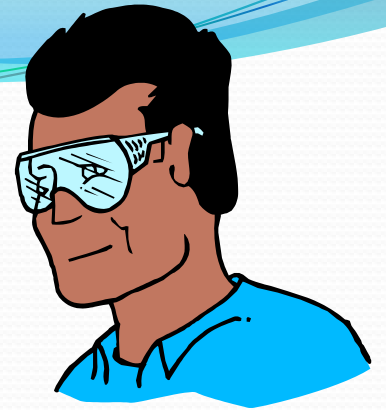
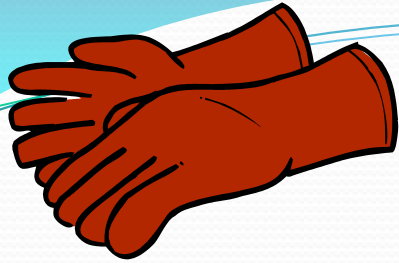


HIGH INTENSITY DISCHARGE LIGHTING MAINTENANCE



Duff Greenwood
Cleaves-Bessmer-Marietti, Inc.
American Electric Lighting



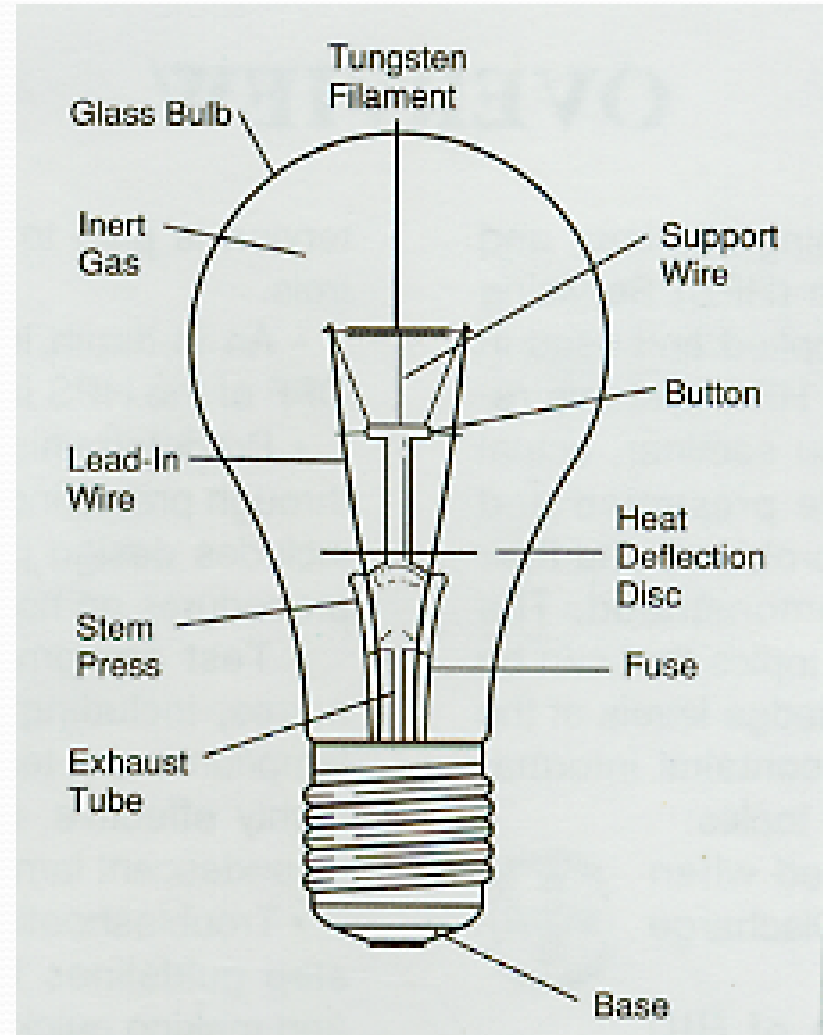
Safety First

- Safety rules and regulations.
- Electricity.
- Power off where possible.



Incandescent Lamp

- Glass envelope
- Screw base with +/- contacts.
- Filament supports.
- Vacuum or inert gas.
- Lamp Failure.
- Dark deposits inside glass bulb.



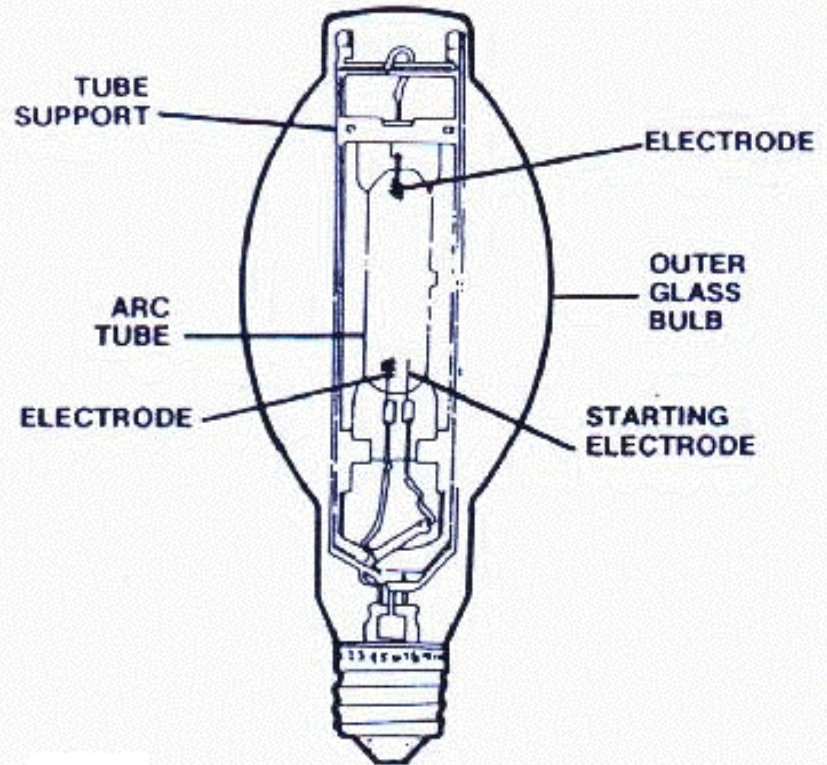
Mercury Vapor HID Lamps

- Peter Cooper Hewitt stumbled upon mercury vapor lighting
- When
 - Turn of the century
- Mercury vacuum pump
 - Droplets of mercury left accidentally in lamp
 - Mercury vaporized and conducted arc



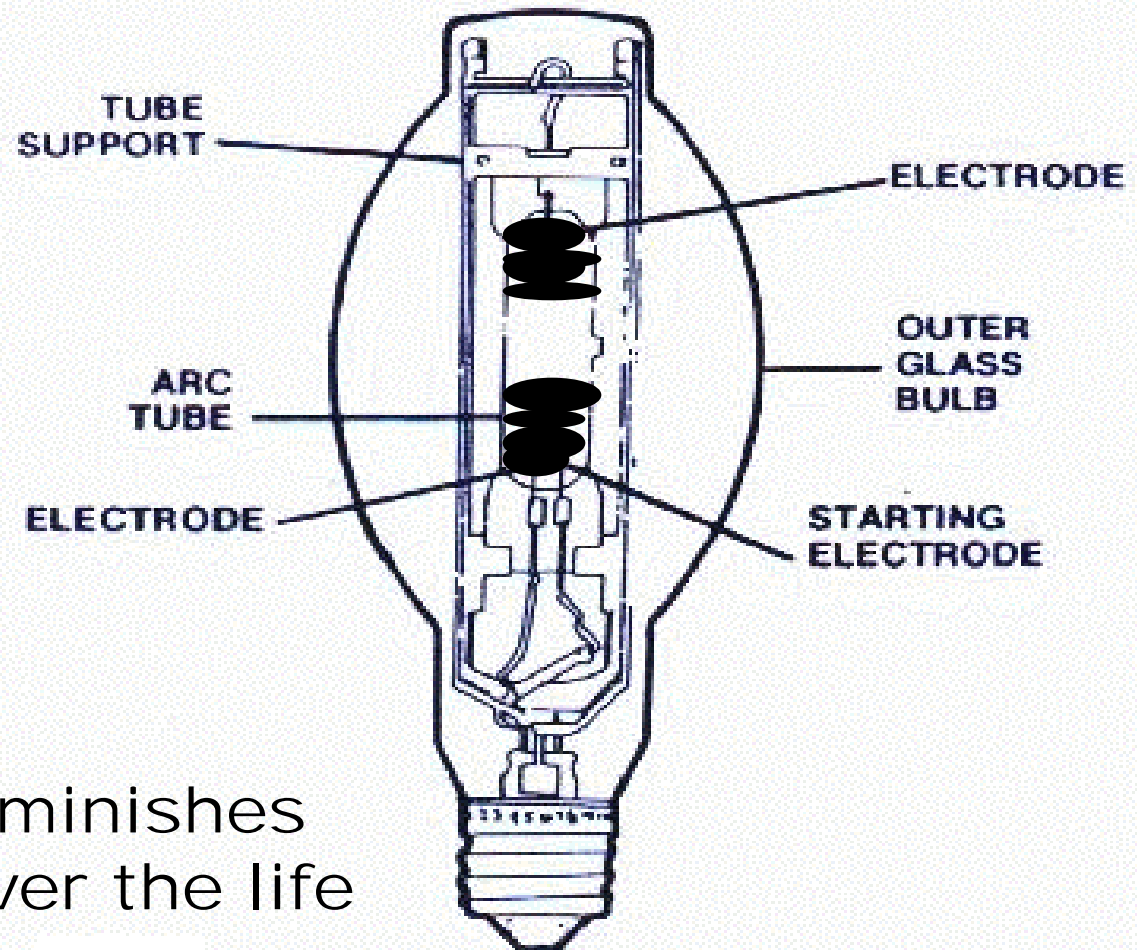
Mercury Vapor

- Open circuit = 240V
- Lamp installed = 130V
- 130V not enough to start
- Similar to Metal Halide
- Important to note that the arc can't start without a start electrode.



MERCURY OR
METAL HALIDE
LAMP

Mercury Vapor



**MERCURY OR
METAL HALIDE
LAMP**

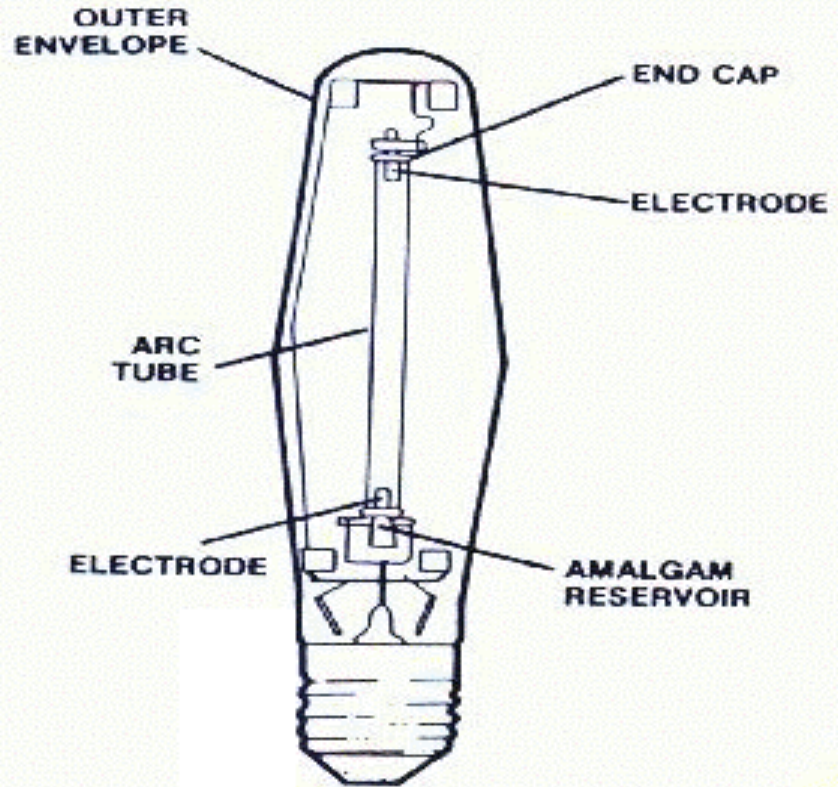
Light output diminishes dramatically over the life of the lamp!

Approximate Lumen Maintenance of Mercury Vapor Lamps



High Pressure Sodium

- More efficient light
- Small arc tube
 - Aluminum oxide
- Electrodes glued in place
 - Silicon glass glue
- No starting electrode!

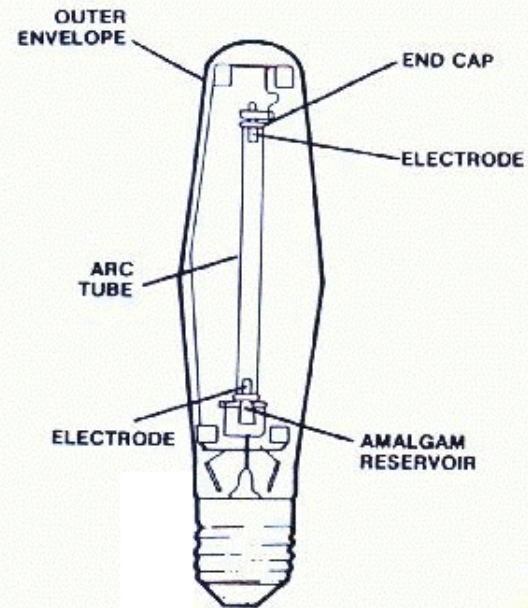


HIGH-PRESSURE
SODIUM
LAMP

DIAGRAM C

High Pressure Sodium

- Open circuit voltage = 120V
- Lamp installed = 55 to 110V
- Need additional voltage to make sodium conductive
- Review of starting aid
 - Orange=condenser
 - Gray cylinder=points
 - Ignition coil=ballast
 - Voltage peaks=switch



HIGH-PRESSURE
SODIUM
LAMP

DIAGRAM C

Starter Operation

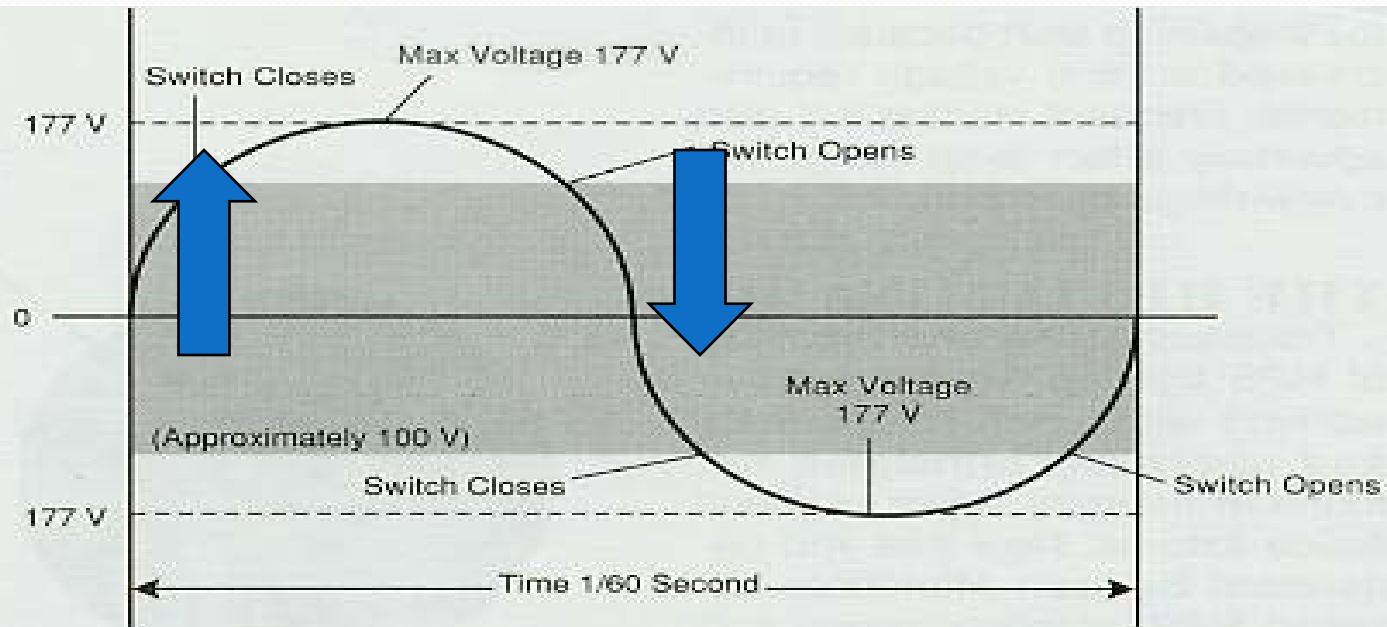


FIGURE 10. The electronic switch in the starter circuit closes every time voltage of the 60 cycle AC power source rises above a certain level.

TABLE 1: HPS LAMP DATA

ANSI Code	Lamp Watts	Rated Lamp Life ¹	Rated Voltage	Minimum Socket Voltage ³	NEW Lamp Voltage Range (at 100 Hours) ²	Nominal Lamp Amps	End-of-Life Lamp Voltage	Average Volts Increase Per 1,000 Hours Life
S76	35	16,000+ Hrs.	52	110	46-62	0.83	84	1.5
S68	50	24,000+ Hrs.	52	110	46-60	1.18	84	1.5
S62	70	24,000+ Hrs.	52	110	45-60	1.60	84	1.5
S54	100	24,000+ Hrs.	55	110	44-62	2.10	84	1.5
S55	150	24,000+ Hrs.	55	110	48-62	3.20	88	1.5
	(55 volts)							
S56	150	24,000+ Hrs.	100	198	85-115	1.80	160	1.5
	(100 volts)							
S66	200	24,000+ Hrs.	100	198	90-115	2.40	160	1.5
S50	250	24,000+ Hrs.	100	198	90-120	3.00	160	1.5
S67	310	24,000+ Hrs.	100	198	90-120	3.60	160	1.5
S51	400	24,000+ Hrs.	100	198	84-115	4.60	140	1.5
S52	1000	24,000+ Hrs.	250	456	210-275	4.70	350	1.5

¹ Rated lamp life is based on 50% survival.

² 100 hours is lamp manufacturer specification for stabilizing light output.

³ Also called open circuit voltage.

CAUTION: Disconnect starting aid lead not common to the lamp to eliminate the starting voltage when checking the minimum open circuit voltage. The high starting voltage might damage your voltmeter.

TABLE 1: HPS LAMP DATA

ANSI Code	Lamp Watts	Rated Lamp Life ¹	Rated Voltage	Minimum Socket Voltage ³	NEW Lamp Voltage Range (at 100 Hours) ²	Nominal Lamp Amps	End-of-Life Lamp Voltage	Average Volts Increase Per 1,000 Hours Life
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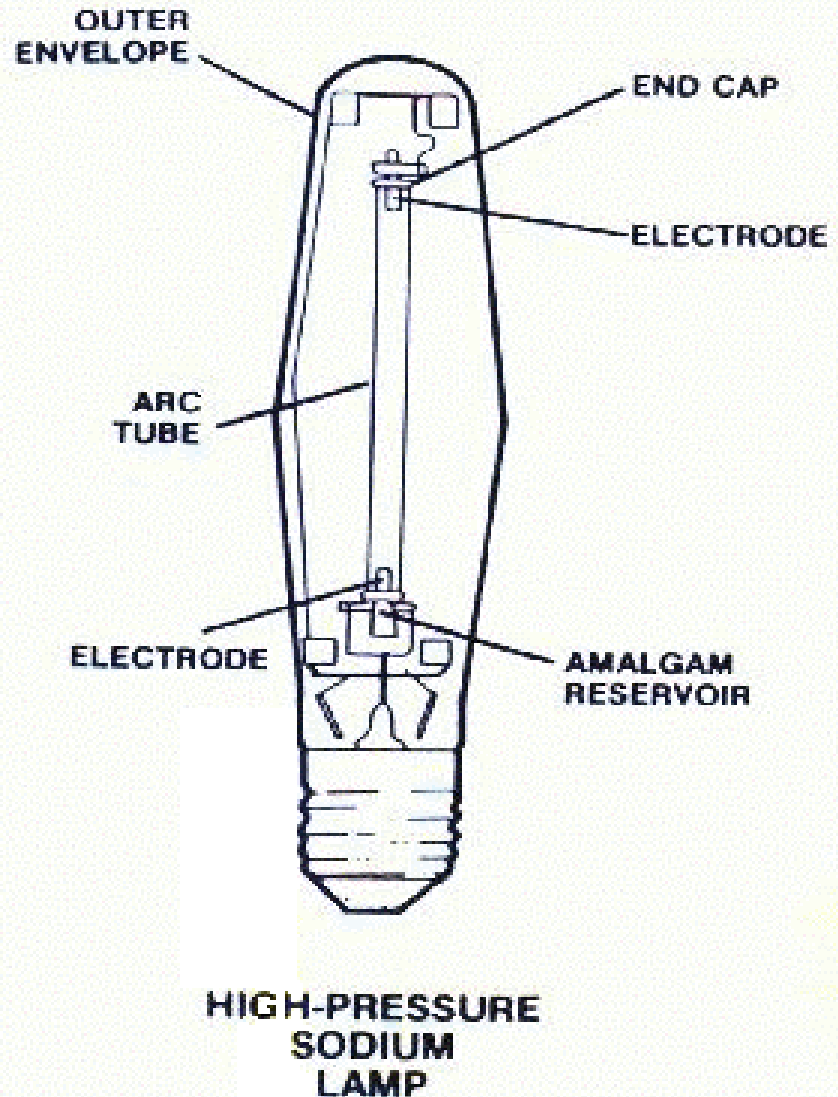
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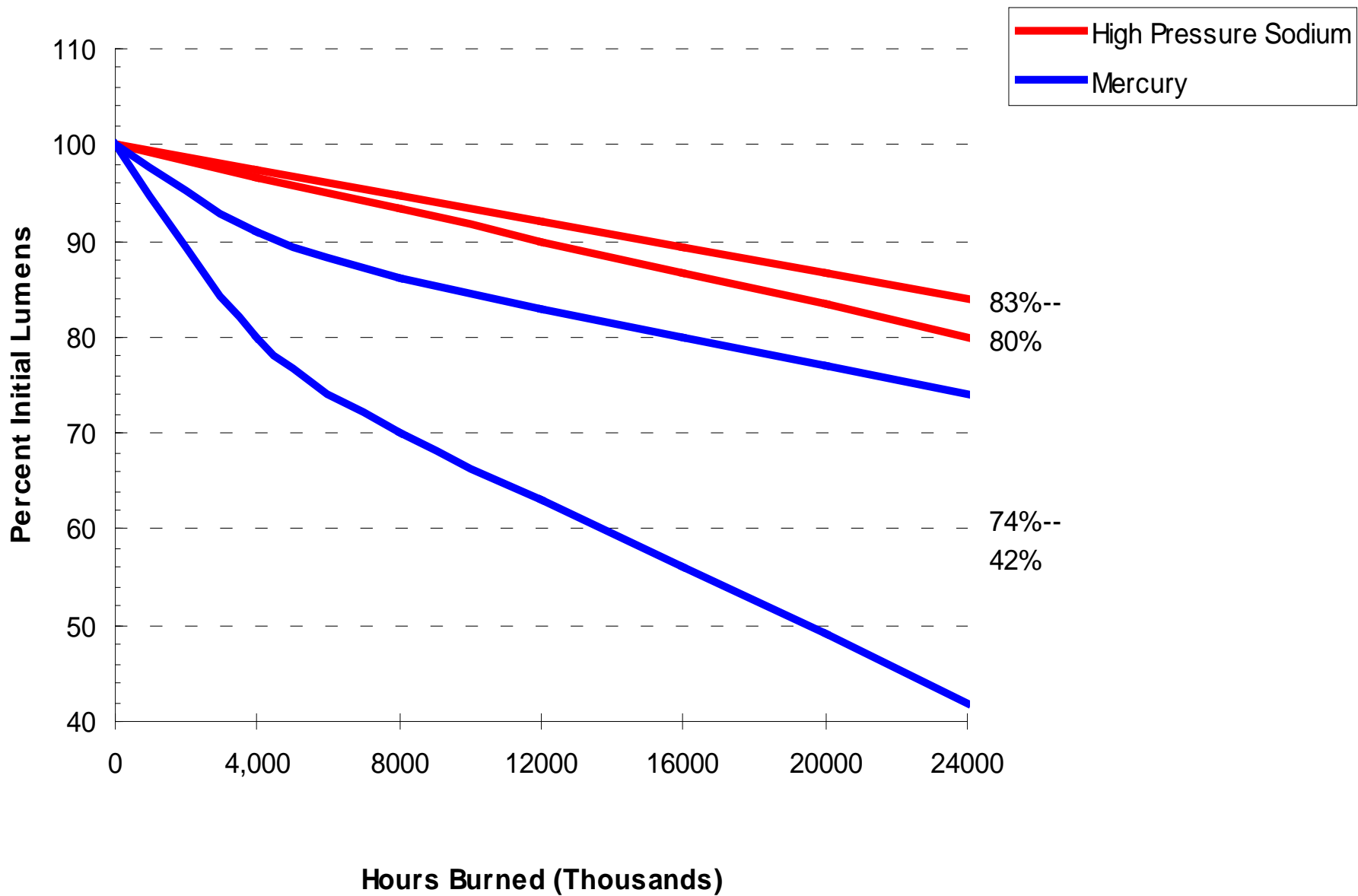
CAUTION: Disconnect starting aid lead not common to the lamp to eliminate the starting voltage when checking the minimum open circuit voltage. The high starting voltage might damage your voltmeter.

HPS Lamp

Light output doesn't decrease as dramatically as Mercury Vapor lamps.



Approximate Lumen Maintenance Mercury Vapor and High Pressure Sodium



Lamp Failure Modes

- Incandescent.
- Mercury Vapor.
- Metal Halide.
- High Pressure Sodium.



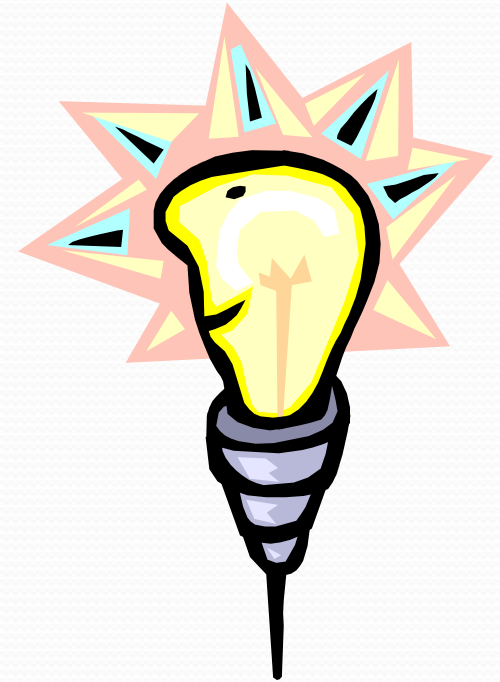


Trouble Shooting

1. Re-ignition Phenomenon.
2. Lamp Installation.
3. Photocontrol Problem.
4. Low Voltage.
5. Broken Weld.
6. Thermal Blink-out.
7. Loose Connections.
8. “Fixture won’t come on.”

Tools required

- 50 W 240V incandescent lamp.
- Shorting cap.
- Power cord.
- Safety equipment.
 - Insulated gloves.
- Known good lamp.
- Volt Meter.





Re-ignition Phenomenon

- Voltage interruptions can cause cycling.
- Voltage passes through zero twice per voltage cycle yet lamp doesn't go out.
- Voltage interruptions longer than several cycles cause cycling.
- Loose connections inside or outside of luminaire/lamp.



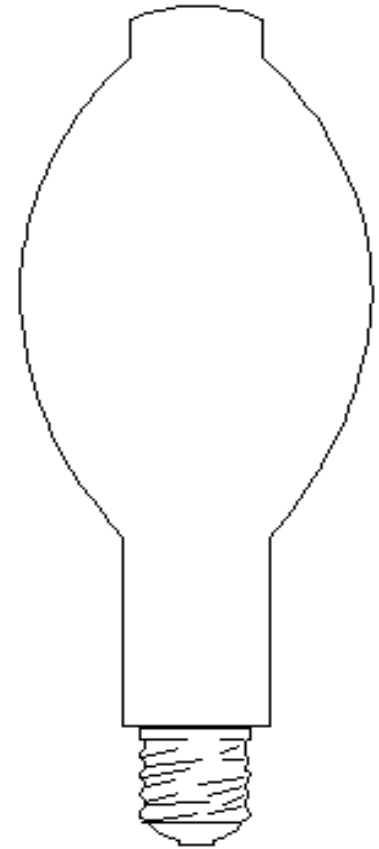
Lamp Installation

Making an electrical connection.

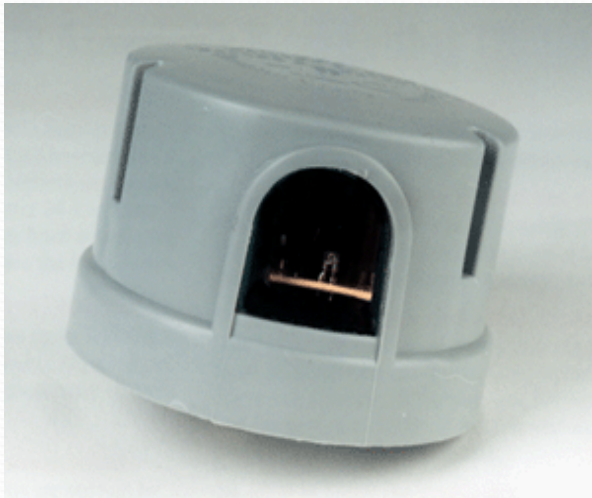
Hot environment.

How tightly should lamp be installed in the lamp socket?

Strokers!



Photocontrol



Automatically controls light.

How it works.

What can go wrong.

Shorting cap eliminates from the circuit.



Low Voltage

Low voltage can cause lamps to cycle.

Volt meter can reveal low voltage.

Duplicate conditions.

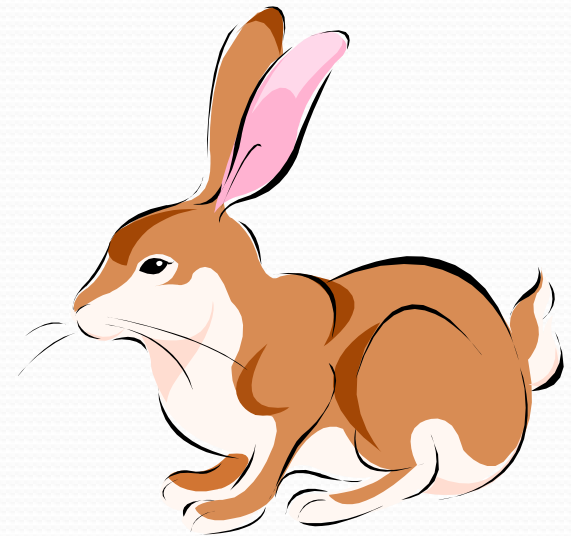
Flushing the light!

Broken Welds:

Lamps contain internal welds.

Arc tube supports are conductors.

Thumpers!





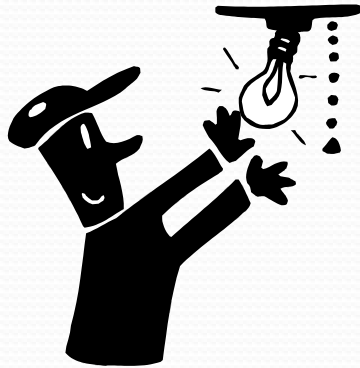
Thermal Blink-Out

Large wattage lamps (1000W, 1500W)

Arc tube reservoir.

Shake, rattle and Roll!

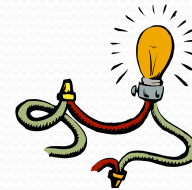
Loose Connections:



- Loose wires cause voltage interruptions.
- Just like incandescent fixture check for loose connections.

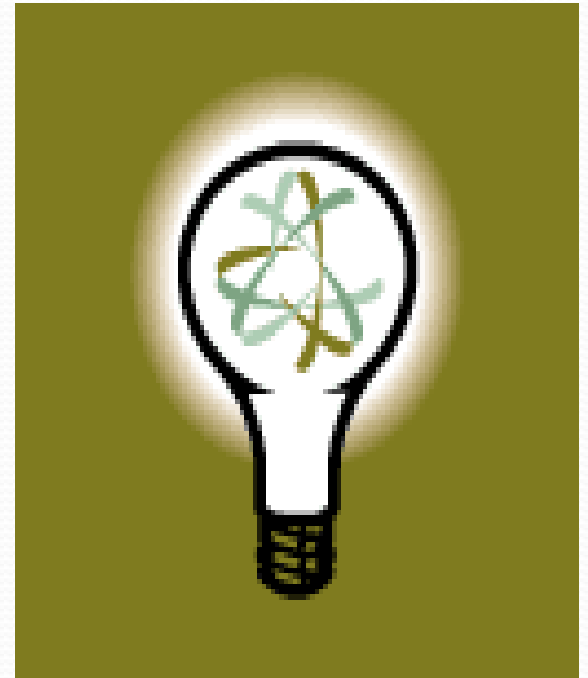
Won't Come On!

- Sometimes the problem won't be obvious.
- Bringing the fixture, lamp and control to the shop might help.
- Look at the **system**.
- Look at the **package**.



Evaluating Luminaires & Lamps

- Testing - Why test?
- Features.
- Ease of installation.
- Performance.
- Ease of maintenance.
- Warranty.
- Services.





Government regulations:

- *Energy Policy Act of 2005:*
 - Fluorescent ballasts
 - Incandescent lamp improvements
 - Mercury Vapor ballasts – 1/1/08



Gov't. Regulations - Continued

- Energy Independence & Security Act
 - Improvements of 20% to 30% required
 - 65% reduction in energy consumed by lighting by 2012!
 - 150 – 500W Probe Start Metal Halide ballasts rendered obsolete on 1/1/09.



Why?

- Incandescent Lamps operating characteristics
 - 95% of energy consumed produces no visible light.
 - Short Lamp life results in excessive maintenance costs.
 - Dramatic light loss over lamp life.



Incandescent vs. CFL

- Incandescent

- 20 LPW
- 1,000 hours
- Low system cost
- Good color
- Good control
- Instant on
- Restart
- Filament failure
- Recycle

- Compact Fluorescent

- 72 LPW
- 6,000 to 15,000 hrs.
- 3 to 10 times more
- Great color choices
- Good control
- 87% then 3 minutes
- Restart good
- Contains mercury amalgam



CFL vs. Mercury

- Compact Fluorescent

- 72 LPW
- 6,000 to 15,000 hrs.
- Low system cost
- Great color choices
- Good control
- 87% then 3 minutes
- Restart good
- Contains mercury

- Mercury Vapor

- 56 LPW
- 24,000 hours
- Medium system cost
- Poor to good color
- Control
- 10 minutes start
- 10 minutes restart
- Contains mercury



Metal Halide Types

- Probe Start (old)

- 100 LPW
- 20,000 hours
- Medium system cost
- Good color
- Poor control
- 10 minutes ON
- 15 minutes restart
- Non-passive failure
- Mercury content

- Pulse Start (new)

- 117 LPW
- 20k to 24k hours
- Slightly higher cost
- Excellent color
- Poor control
- 10 minutes ON
- 10 minutes restart
- Non-passive failure
- Mercury content



New Technologies

Solid State Light Sources

- LED
- Induction
- Plasma



Light Emitting Diode (LED)

- Latest lighting technology
 - System life approaching 100,000 hours
 - Improving lumen output
 - Confusion in the market!
 - Photometrics
 - Recognized lighting standards
 - Photopic vs. Scotopic light levels
 - “System Life” new term
 - Prices



LED vs. HPS

- Light Emitting Diode
 - 115 LPW reported
 - 25k to 100k system
 - High initial cost
 - Excellent color
 - Excellent control
 - Instant ON
 - Instant restrike
 - Reduced light output
 - No mercury content

- High pressure sodium
 - 125 LPW
 - 24,000 hours
 - Cost equal to MH
 - Acceptable
 - Poor control
 - 10 minutes ON
 - 10 minutes restrike
 - Cycling
 - Mercury content



Other Solid-State Lighting

- Electrode-less lamp
- Electromagnetic Fields
- Advantages:
 - Extended lamp life
 - high efficiency light-generating substances
 - Improved collection efficiency



Induction Lighting

- Electromagnetic induction with no electrical connections inside the lamp or vessel.
- Electronic (solid-state) ballast or frequency generator
- Internal induction used today for lighting applications.
- Produces short-wave ultraviolet light
- Excite phosphors to produce visible light



Plasma Lighting

- Uses radio frequency inside a vessel to excite plasma
- Excited particles emit photons
- Expensive components



DOE Municipal Consortium

- Solid-State Street Lighting Consortium
 - Shares technical information
 - Shares experiences with new lighting products
 - Evaluates new solid-state lighting products
- Membership
 - Open to municipalities, utilities, and energy efficiency organizations
 - <http://www1.eere.energy.gov/buildings/ssl/consortium.html>



QUESTIONS?